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Corrosion Assessment Criteria: Rationalizing Their Use Applied to Early Versus Modern Pipelines

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Technical Status

Work in the several preceding quarters has developed guidelines for the use of corrosion assessment criteria to ensure factors such as constraint induced by the defect geometry and pipeline loadings do not promote fracture control as such criteria are valid only for scenarios where failure is controlled by plastic collapse. The work to date supports the approach proposed to rationalize differences in the format of the 70s and 90s criteria, wherein geometric and stress-state-induced constraint along with lower fracture toughness were postulated as the reason the 70s criteria were calibrated with a flow stress whose value was much less than the UTS.

The focus of the past work has been analytical. The present quarter completed full-scale testing to explore the viability of the prior criteria and explore the mechanics of failure of corrosion along weld seams. The results developed showed failure at macroscopically blunt corrosion at pressures ranging from 74-percent to 145-percent of that predicted by the 70s criteria – all within the same piece of line pipe. As all results involve the same line pipe, property differences were minimized such that only geometric factors such as constraint must underlie the significantly different failure pressures. Heretofore, where such differences had been observed, they were rationalized as scatter or uncertainty in line pipe properties. The lowest failure pressure was found to involve failure along the weld seam at small high-constraint defects, that at the next highest pressure involved failure at larger features with lower constraint, while the highest pressure occurred remote to the weld, although cracking was evident in the weld. These full-scale test results thus support the proposed approach to rationalize differences between 70s and 90s criteria to assess corrosion severity.

The analytical work will continue to focus on constraint effects in laboratory specimens and in pipeline scenarios. Work continues to quantify these in reference to pipeline applications in terms of the vintage, grade, and other metrics that characterize the flow response of the line pipe such as strain hardening exponent and yield to tensile ratio.

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